

Transmit/Receive (T/R) Module Laboratory



The RF Sensors Branch possesses an independent evaluation capability to assess the performance of Transmit/Receive (T/R) modules through the use of in-house government personnel and laboratory facilities. Examples of test equipment currently available in this lab are: a network analyzer, spectrum analyzer, microwave amplifiers, oscilloscope, noise figure meters, power meters and pulse function generators.

Typical T/R Module Performance Characterization Tests Performed:

Transmit and Receive Gain/Loss:

Receiver Gain Measurement - This test is conducted with an HP 8510 network Analyzer with appropriate bias conditions imposed. Test conditions are set to measure the minimum gain. The gain of the module is measured with the transmitter on and off to study the effects of the transmitter components on the performance of the receiver.

Transmit Gain Measurement - This test is also conducted with the HP 8510 network analyzer with pulsed measurement capability. Test conditions are set to vary the duty cycle and pulse width around the nominal values specified for T/R module, to determine the effects on transmitter gain. This testing is also conducted with the receiver turned on and off.

Gain Control and Performance Stability Measurement - Gain control of a module is monitored as a function of frequency and signal levels. Also phase modulation due to ripple on control lines and phase change with gain are monitored. The gain of the module is monitored over a number of hours with periodic measurements to determine the performance stability of the module.

VSWR Measurements - The HP 8510B network analyzer is used to measure the return loss of a module. VSWR vs frequency measurements are taken at the input and output manifolds over the full range of phase and gain settings.

Power Measurement/Transmit and Receive - To measure the RF power, two different methods are used. Method one uses the network analyzer to measure input power vs. gain of the module. The second method uses a power meter to obtain the actual input and output power of a module.

Third Order Intercept Point Measurement - A two tone intermodulation product measurement is made using a spectrum analyzer to measure how far down the third order products are from the carrier. The third order intercept point is found by extrapolating the third order power to the point where it intersects the fundamental component.

Power added-Efficiency - The input DC bias power and RF input power is measured and compared with the RF power out to determine the power added efficiency of the module.

Receive Noise Figure: Noise figure measurements vs gain, frequency, and phase are taken at intervals over the full operating range of the receive channel using a noise figure meter.

Tx/Rx Switching Time -This measurement is conducted using a digital oscilloscope and a network analyzer. By monitoring the insertion loss of the switch, the position of the switch can be determined. The test condition is set to measure the maximum switching time.

TX turn on/off time -The transmit rise and fall time and pulse droop/phase linearity are measured using both constant and chirped excitations over the full transmit frequency range with an HP 8510 or equivalent network analyzer and oscilloscope.

Phase Error Measurement - The HP 8510 network analyzer is used to measure the insertion loss phase. The test condition will be set to measure the phase error to specific RMS maximum.

Benefit to the Navy - This Lab provides a unique, independent, in-house evaluation capability to assess the performance of microwave T/R modules by conducting full electrical performance measurements and evaluating module specification compliance.

For more information contact the Transmit and Receive Module Laboratory at the Naval Air Warfare Center Aircraft Division, Patuxent River, MD at 301-342-xxxx.